IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Before the Board of Patent Appeals and Interferences

Applicants:	Carl W. Gerst, III, *et al.*
Appl. No.:	10/693,626
Filed:	Oct. 24, 2003
For:	LIGHT PIPE ILLUMINATION SYSTEM AND METHOD
Art Unit:	2876
Examiner:	Allyson N. Trail
Docket No.:	C03-006 (210736.00041)

APPELLANT'S BRIEF ON APPEAL

MS Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Appellants, having filed a timely Notice of Appeal in the above-identified patent application, hereby submits this brief.

I. REAL PARTY IN INTEREST

The present application is assigned to Cognex Technology and Investment Corp., a corporation having a place of business at Mountain View, CA.

II. RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences.

III. STATUS OF CLAIMS

Claims 1-35 are currently pending in the subject patent application. In the final office action dated February 22, 2008, claims 1, 3, 5 - 8, 23, 24, 26 - 28, 30 - 33, and 35

were rejected under 35 U.S.C. Section 102(e) as unpatentable over Fukumoto, U.S. Patent 6,621,065. Claims 4 and 25 have been rejected under 35 U.S.C. Section 103(a) as unpatentable over Fukumoto in view of Hattersley, U.S. Patent Publication 2002/0000472. Claims 9, 10, 29, and 34 have been rejected under 35 U.S.C. 103(a) as unpatentable over Fukumoto in view of Patel, U.S. Patent Publication 2003/0080189.

Claims 11 - 22 have been indicated as allowable. Claim 2 has been objected to, but as allowable if rewritten in independent form. This appeal is taken with respect to claims 1, 3 - 10, and 23 - 35, which are set forth in Appendix A hereto.

IV. STATUS OF AMENDMENTS

The application was filed with 35 claims on October 24, 2003. All amendments to the claims have been entered.

V. SUMMARY OF CLAIMED SUBJECT MATTER

As noted above, claims 1, 3 - 10, and 23 - 35 are the subject of this appeal. Of these, claims 1, 23, 30, and 34 are independent claims.

Each of the independent claims is directed to an illuminator for illuminating a subject that is imaged by an imaging sensor. Each of the claims recite a ring light source that communicates with a light pipe. The light pipe includes a tip that is adapted to project an illumination pattern. The illumination pattern can provide a low-angle dark field illumination pattern, a high-angle bright field illumination, or can be configured to illuminate a reduced area with respect to the field of view of the camera to allow for improved aiming of the camera.

Referring now to Figs. 1, 3 and 4; page 6, lines 6 - 8; and page 8 lines 6 - 26 of the application as filed, the light pipe (142, 420) is an "extended barrel of light

transmissive material" which acts as a "wave guide for visible and near visible light". A ring light source (334, 410) directs the light through the light pipe (340, 420). Light is transmitted through the light pipe 142 and onto an underlying surface that includes an area of interest 130.

Claims 1 and 34 specifically recite that the tip of the light pipe is adapted to project a low-angle dark field illumination pattern. Referring still to Figs. 1, 3 and 4, to provide this illumination pattern, the tip (144, 340, 430) is angled, typically at an angle of no more than approximately 45 degrees with respect to the surface, or no more than 45 degrees to the optical axis, which causes internal reflection within the light pipe that projects a low-angle dark field illumination. (Page 6, lines 7 - 12). The light is reflected inwardly toward the central optical axis of a camera (page 3, lines 11 - 13) to provide the low angle illumination (page 8, lines 20 - 21). An external bright field illuminator (450 or 460) can also be provided.

Claim 23 requires a tip that is adapted to project a high-angle bright field illumination. Referring now also to Fig. 5, here again a light pipe (520) is shown communicating optically with a ring illuminator (512). The bright field illumination pattern is produced by a tip (522) at the end of the pipe (520) that is rounded or flat. The tip (522) can also include a diffusing surface texture for enhanced scatter of bright field light (see page 11, lines 17 - 20).

Claim 30 recites an illumination pattern that covers a reduced area with respect to the field of view. The illumination pattern highlights an aiming location. This illumination pattern is discussed at page 3, lines 14 - 19 of the application, which describes an illumination field created by shaping the light pipe in a particular shape. The light pipe limits the field of view, so that the camera sensor rejects data outside of the

illumination field. Referring now also to Fig. 9, an example is shown. Here, the light pipe 904 is constructed to have a rectangular cross section which restricts the native field of view of the sensor. (Page 13, lines 15 - 19). In this example, the light pipe 904 is used to project a pattern similar in shape to a bar code being read. Because of the illumination pattern, a user is prompted to align the pattern with the code being read. The user receives immediate feedback as to the location of the field of view, which conforms to the outline of the subject bar code. (Page 13, lines 20 - 25)

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Whether claims 1, 3, 5 - 8, 23, 24, 26 - 28, 30 - 33, and 35 are unpatentable under 35 U.S.C. Section 102(e) over Fukumoto, U.S. Patent 6,621,065?

Whether claims 9, 10, 29, and 34 are unpatentable under 35 U.S.C. 103(a) over Fukumoto in view of Patel, U.S. Patent Publication 2003/0080189?

Whether claims 4 and 25 are unpatentable under 35 U.S.C. Section 103(a) over Fukumoto in view of Hattersley, U.S. Patent Publication 2002/0000472?

VII. ARGUMENT

A. Prior Art References.

As discussed above, independent claims 1, 23, and 30 are rejected as anticipated by Fukumoto, U.S. Patent 6,621,065. Independent claim 34 is rejected as unpatentable under 35 U.S.C. 103(a) over Fukumoto in view of Patel, U.S. Patent Publication 2003/0080189. These references are discussed below. To limit the issues, the Hattersley reference, which has been cited only in the rejection of dependent claims, is not discussed.

1. The Fukumoto Reference. Fukumoto discloses an imaging probe, specifically designed to be mounted to a three-dimensional tester through a mounting block 12. In the probe, a light reflected from a subject to be imaged is transmitted through an object lens 24, is condensed by a focusing lens 26, and is focused on an imaging sensor 27. (Col. 4, lines 2 - 5) Two light sources are provided for illuminating the subject: a ring illumination source 13 and a down projection illumination source 31. (Fig. 2)

The ring illumination source 13 is mounted on an annular frame 71 at a distal end of a housing 11 of the imaging device, and "surrounds the object lens 24" (col. 5, lines 6 - 7; Fig. 2). Light emitted from the ring illumination source 13 is directed through a diffusing plate 74, to provide uniform illumination from the source 13 (See column 5 lines 15 - 18; Fig. 5A).

The light emitted from the down projection illumination source 31 is directed to a mirror 42 which in turn directs the light through the lens 24. This light is also directed through a diffusing plate 33 (Fig. 2) to provide uniform brightness (Col. 5, lines 20 - 22).

All of the light projected from the illumination sources in the imaging probe is therefore diffused, e.g. spread out over a large area, not concentrated (Concise Oxford English Dictionary, Oxford University Press, 2004; see also Websters New Universal Unabridged Dictionary, Barnes & Noble Publishing, 2003 (spread or scatter widely); The American Heritage Dictionary, Dell Publishing, 2001 (widely spread or scattered). The specification, moreover, specifically states that the purpose of the diffusing elements is to provide uniform illumination light (col. 5, lines 15 - 22).

2. The Patel Reference. The Patel reference discloses a bar code reader that includes lasers or light emitting diodes that assist in aiming of the disclosed imaging system. (Paragraph 11)

B. Argument

1. Rejection of Independent Claims 1, 23, and 30. Claims 1, 23, and 30 have been rejected as anticipated under 35 U.S.C. Section 102(e) by Fukumoto. Fukumoto, however, fails to disclose all of the elements of claims 1, 23, and 30. Therefore, the rejection of independent claims 1, 23, and 30 and the associated dependent claims is improper and should be reversed.

a. Fukumoto Fails to Disclose a Light Pipe. As described above, independent claims 1, 23, and 30 each recite a light pipe. As described in the specification, a light pipe is a device that includes an "extended barrel of light transmissive material". The pipe acts as a "wave guide for visible and near visible light". Light, therefore, is clearly directed through a light pipe. This definition, moreover, is the commonly understood definition of the term, as found, for example, in Websters New Universal Unabridged Dictionary, Barnes & Noble Publishing, 2003, which defines a light pipe as "an elongated transparent medium, such as an optical fiber, for transmitting light". (See Evidence Appendix)

Fukumoto, does not disclose a light pipe, as recited in each of the rejected independent claims. Fukumoto does not disclose any pipe that is constructed of a light transmissive material. Fukumoto, in fact, does not disclose any pipe that is capable of transmitting light. Fukumoto does not disclose any pipe that functions as a waveguide. Fukumoto, therefore, cannot anticipate any of the independent claims 1, 23, and 30, and the rejection of these claims and associated dependent claims should be overturned for this reason.

b. Fukumoto Fails to Disclose A Ring Light Source Communicating Light through a Light Pipe. Independent claims 1, 23, and 30 further recite a ring light source communicating with a light pipe, e.g. a ring light source that communicates optically with a light pipe to transmit light into and through the pipe. As described above, Fukumoto discloses a ring illumination source 13 that is mounted to a distal end of a chassis 71. Referring to Fig. 5A and column 5 lines 15 - 18, light from the illumination source 13 is not directed through any light pipe, but is rather communicated through a diffusing plate 74. Fukumoto neither discloses nor suggests communicating light from a ring light source and through a light pipe.

c. Fukumoto Fails to Disclose a Tip Adapated to Project a Pattern of Illumination. Each of the independent claims 1, 23, and 30 further recite the limitation that the light pipe includes a tip adapted to project an illumination pattern. With respect to claims 1 and 34, the tip is specifically angled to provide a low-angle dark field illumination pattern on the underlying surface, particularly of light exiting the tip. With respect to claim 23, the tip is adapted to project a high-angle bright field illumination pattern with respect to the subject. With respect to claim 30, the tip is adapted to provide an illumination pattern that covers a reduced area with respect to the field of view to aid in aiming of the device.

As discussed above, Fukumoto fails to disclose a light pipe, and further fails to disclose a ring light source in communication with the light pipe. As Fukumoto fails to disclose a light pipe, this reference cannot disclose a light pipe that includes a tip adapted to project an illumination pattern. On the contrary, as discussed above, the illumination

ring 13 disclosed by Fukumoto communicates only with a diffuser that is specifically intended to provide uniform illumination.

With respect to claims 1 and 23, the Examiner asserts that, because the probe can be "employed at any angle" (citing the background section at col. 1, lines 49 - 50), the tip of the light pipe 13 can be adapted to project either high-angle bright field illumination pattern or low angle dark field illumination pattern with respect to the subject. This is not the case.

As described above, dark field illumination is illumination at a low angle (forty-five degrees or less) with respect to the surface of the subject. The purpose of "swaying the imaging probe", as discussed at col. 1, lines 54 - 57, is not to adjust the angle of illumination with respect to the surface of the subject, but to allow "any imaging direction". Adjusting the angle of the probe does not adjust the angle of illumination, because all of the optical components of the probe, including the illumination ring 13, the object lens 24, and the sensor 27, are adjusted together. In use, the subject is aligned with the lens 24. The illumination ring 13 remains in exactly the same position relative to the lens, and to the subject, irrespective of the angle of the probe. The angle of the light with respect to the subject, therefore, does not change at all. Angling the probe cannot produce bright or dark field illumination.

Angling the imaging device of Fukumoto, moreover, cannot result in directing the light at any particular angle with respect to the surface of the subject, since the light has been intentionally diffused.

With respect to claim 30, the Examiner asserts that "the light pipe 13 reduces the field of view of the image sensor. Without the light pipe 13, the illumination provided by the ring of light would not be contained."

The issue here, however, is not whether the illumination is "contained", but whether the field of view is reduced. The field of view is the portion of the subject that can be imaged by the sensor, and therefore that is visible to the sensor at a particular position and orientation. As can be clearly seen from Fig. 2 of Fukumoto, the subject is viewed through the lens 24, which determines the field of view. The ring illumination source 13 surrounds the housing of the lens 24. The ring illumination source 13 and associated housing 11 therefore cannot in any way affect the field of view.

Fukumoto, therefore, fails to disclose any light pipe that includes a tip adapted to project an illumination pattern. Fukumoto fails to disclose any light pipe that produces a dark field illumination. Fukumoto fails to disclose any light pipe that reduces the field of view of the image sensor. In view of these distinctions, the rejection of these claims under 35 U.S.C. Section 102(e) is inappropriate, and the Applicants respectfully request that the rejection be withdrawn.

2. Rejection of Independent Claim 34. The rejection of independent claim 34 under 35 U.S.C. Section 103(a) as unpatentable over Fukumoto in view of Patel, U.S. Patent Application 2003/0080189, is improper and should be reversed.

Claim 34 recites a ring light source communicating with a light pipe. The light pipe includes a tip adapted to project a low-angle dark field illumination pattern on a subject being illuminated. As discussed above with reference to claims 1, 23, and 30, Fukumoto does not disclose a light pipe, communicating light through a light pipe, or communicating light through a tip of a light pipe. The Patel reference is cited only for disclosing light emitting diodes for aiming, and does not rectify any of the problems with the Fukumoto reference discussed above.

Therefore, claim 34 is patentable over the cited combination for the same reasons as set forth above with respect to Claims 1, 23, and 30. The rejection of claim 34 under 35 U.S.C. Section 103 is improper and should be reversed.

VIII. CONCLUSION

In view of the arguments above, the Applicants respectfully submit that the rejection claims 1, 3 - 10, and 23 - 35 is improper. Fukumoto, as discussed above, fails to disclose a light pipe. Fukumoto fails to disclose a ring light source that communicates with a light pipe. Fukumoto fails to disclose a light pipe having a tip that is adapted to provide an illumination pattern. Fukumoto, therefore, fails to provide a proper basis for rejection under either 35 U.S.C. Section 102, or 35 U.S.C. Section 103. In view of the cited distinctions, therefore, the Appellants respectfully request that the rejection be overturned.

Respectfully submitted,

Dated: Oct. 20, 2008

By: _____

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APPENDIX A

1. An illuminator for illuminating a subject that is imaged by an image sensor comprising:

a first ring light source arranged around a perimeter of a predetermined shape communicating with a first light pipe defining a hollow tube having a cross-section with the predetermined shape, the first light pipe defining an inner lumen through which the sensor views the subject and the light pipe including a tip adapted to project a low-angle dark field illumination pattern on the subject; and

an electronic controller that selectively controls predetermined portions of the first ring light source to project a variable light around the perimeter.

3. The illuminator as set forth in claim 1 wherein the predetermined shape defines a circle.

4. The illuminator as set forth in claim 1 wherein the predetermined shape defines a rectangle.

5. The illuminator as set forth in claim 1 wherein the perimeter of the predetermined shape defines a shape that reduces a field of view of the image sensor.

6. The illuminator as set forth in claim 1 wherein the predetermined shape defines a curved shape.

7. The illuminator as set forth in claim 1 wherein the predetermined shape defines a shape conforming to dimensions of a predetermined subject.

8. The illuminator as set forth in claim 1 wherein the first light pipe and the first ring light source are each mounted on a handheld scanning appliance.

9. The illuminator as set forth in claim 8 further comprising a set of light sources that each project a beam at a predetermined point with respect to the subject to thereby assist aiming of the image sensor at the subject.

10. The illuminator as set forth in claim 1 further comprising a set of light sources that each project a beam at a predetermined point with respect to the subject to thereby assist aiming of the image sensor at the subject.

23. An illuminator for illuminating a subject that is imaged by an image sensor comprising:

a ring light source arranged around a perimeter of a predetermined shape communicating with a light pipe defining a hollow tube having a cross-section with the predetermined shape, the light pipe defining an inner lumen through which the sensor views the subject and the light pipe including a tip adapted to project a high-angle bright field illumination pattern with respect to the subject.

24. The illuminator as set forth in claim 23 wherein predetermined shape defines a circle.

25. The illuminator as set forth in claim 23 wherein predetermined shape defines a rectangle.

26. The illuminator as set forth in claim 23 wherein the perimeter of the predetermined shape defines a shape that reduces a field of view of the image sensor.

27. The illuminator as set forth in claim 23 wherein the predetermined shape defines a shape conforming to dimensions of a predetermined subject.

28. The illuminator as set forth in claim 23 wherein the light pipe and the ring light source are each mounted on a handheld scanning appliance.

29. The illuminator as set forth in claim 23 further comprising a set of light sources that each project a beam at a predetermined point with respect to the subject to thereby assist aiming of the image sensor at the subject.

30. An illuminator for illuminating a subject that is imaged by an image sensor having a field of view comprising:

a ring light source arranged around a perimeter of a predetermined shape communicating with a light pipe defining a hollow tube having a cross-section with the predetermined shape, the light pipe defining an inner lumen through which the sensor views the subject and the light pipe including a tip adapted to project an illumination pattern with respect to the subject; and

wherein the illumination pattern covers a reduced area with respect to the field of view whereby an aiming location is highlighted by the illumination pattern.

31. The illuminator as set forth in claim 30 wherein the light pipe includes a tip adapted to project a high-angle bright field illumination.

32. The illuminator as set forth in claim 30 wherein the light pipe includes a tip adapted to project a low-angle dark field illumination.

33. The illuminator as set forth in claim 30 wherein the light pipe is mounted on a handheld scanning appliance.

34. An illuminator for illuminating a subject that is imaged by an image sensor comprising:

a first ring light source arranged around a perimeter of a predetermined shape communicating with a first light pipe defining a hollow tube having a cross-section with the predetermined shape, the first light pipe defining an inner lumen through which the

sensor views the subject and the light pipe including a tip adapted to project a low-angle dark field illumination pattern on the subject; and

a bright field illuminator located external to the light pipe.

35. The illuminator as set forth in claim 34 wherein the bright field illuminator comprises a ring coaxial with the light pipe.

EVIDENCE APPENDIX

ock′, an American mantel clock of the ry, having the dial and works exposed dome on a tapered, cylindrical body.

f′feepot, a coffeepot of the late 17th es, having a tapering, circular body with

′oint′, a city in SE Florida. 11,488.

ibe′, *Electronics.* a vacuum tube with rranged in parallel layers closely spaced, ely high-power output at high frequen-

gust, a novel (1932) by William Faulk-

try, 1. foot soldiers with lightweight inimal field equipment. 2. infantry units d number of crew-served weapons and g equipment. [1840–50]

ing), *n.* 1. the act of igniting or illumi- *ting of many candles; the annual lighting as tree.* 2. the arrangement of lights to ular effects: *to work out the lighting for* m. 3. an effect achieved by the arrange- *Several critics praised the lighting of the* ience; theory, or method of achieving par- by the use of lights. 5. the way light falls bject, etc., esp. in a picture. [bef. 1000; ME *lihting.* See LIGHT¹, -ING¹]

tish), *adj.* rather light in color. [1650–60; t]

tish), *adj.* rather light in weight. [LIGHT²

s.

l′ess), *adj.* 1. without light or lights; re- t; dark. 2. giving no light. [bef. 1000; ME *ohtlēas.* See LIGHT¹, -LESS] —**light′less-**

Naut. the line or level to which a ship or n fully supplied with fuel and ballast but Also called **light′ load′ line′.** [1890–95]

adv. 1. with little weight, force, inten- *to press lightly on a door bell.* 2. to mount or degree; slightly: *lightly fried* quickly: *to leap lightly aside.* 4. with a indifferently; slightly: *to think lightly of* 5. cheerfully; without complaining: ightly. 6. without due consideration used negatively): *an offer not to be* 7. easily; without trouble or effort: ly go. 8. frivolously; flippantly: *to be-* ly; buoyantly: *flags floating lightly.* OE *lēohtlice.* See LIGHT², -LY]

gun′, *Mil.* any air-cooled machine not greater than 0.30 in. (7.6 mm).

ite meat (defs. 1, 2).

exposure meter. [1920–25]

microscope (def. 1). [1940–45]

d′did), *adj.* having or showing a attitude, etc.; frivolous; trifling: *ed mood.* [1605–15] —**light′-** **t′-mind′ed·ness,** *n.*

any rock-forming mineral that of less than 2.8 and is generally **neral.**

Chem. See under **mineral oil.**

the state or quality of being *ing lightness of the new metal.* nimble, or graceful. 3. lack ness. 4. lack of seriousness; or speech: *That kind of light-* gaiety of manner, speech, *lightness was just what the* ME. See LIGHT², -NESS]

mbleness, sprightliness.

the state or quality of being or pale coloration. 3. the object reflects light, esp. arly complementary colors. ee LIGHT¹, -NESS]

ed, -ning. *adj.* —*n.* 1. charge in the atmosphere, ud, between clouds, or be- —*v.i.* 2. to emit a flash sed impersonally with *it ing, we'd better go inside.* esembling lightning, esp. *lightning flashes; light-* var. of *lightening.* See

e for preventing damage lectric equipment from currents, using spark gaps to carry the current to the ground without passing through the device. Also called **arrester.** [1855–60]

light′ning bug′, firefly. [1770–80, *Amer.*]

light′ning rod′, 1. a rodlike conductor installed to divert lightning away from a structure by providing a direct path to the ground. 2. a person or thing that attracts and absorbs powerful and esp. negative or hostile feelings, opinions, etc., thereby diverting such feelings from other targets: *The unpopular supervisor served as a lightning rod for the criticism that should have been aimed at management.* [1780–90, *Amer.*]

light-o′-love (līt′ə luv′), *n.* 1. a lover. 2. a prostitute. Also, **light-of-love** (līt′əv luv′). [1570–80]

light′ op′era, operetta. [1880–85, *Amer.*]

light′ pen′, *Computers.* a hand-held light-sensitive device used for pointing at characters or objects on a CRT in order to make or modify drawings or to indicate functions to be performed. Also called **light′ pen′cil.** [1955–60]

light′ pipe′, *Optics.* an elongated transparent medium, such as an optical fiber, for transmitting light. [1945–50]

light·plane (līt′plān′), *n.* a lightweight passenger airplane with relatively limited performance capability. [1920–25; LIGHT² + (AIR)PLANE]

light′ pollu′tion, 1. unwanted or harmful light, as from bright street lights or neon signs. 2. *Astron.* artificial illumination of the sky that sets a limit on the faintness of stars that can be observed or photographed. [1970–75]

light·proof (līt′prōōf′), *adj.* impervious to light: *a lightproof film cartridge.* [1920–25; LIGHT¹ + -PROOF]

light′ quan′tum, *Physics.* photon. [1920–25]

light-rail (līt′rāl′), *adj.* of or pertaining to a local rail rapid-transit system using large, single passenger cars, railroad-type signals, and, usually, private rights-of-way. [1975–80]

lights (līts), *n.pl.* the lungs, esp. of sheep, pigs, etc. [1150–1200; ME *lihte, lightes,* n. use of *liht* LIGHT²; cf. LUNG]

light·ship (līt′ship′), *n.* a ship anchored in a specific location and displaying or flashing a very bright light for the guidance of ships, as in avoiding dangerous areas. *Abbr.:* LS [1830–40; LIGHT¹ + SHIP]

light′ show′, a form of entertainment consisting chiefly of constantly changing patterns of light and color, usually accompanied by music and sound effects. [1965–70]

light·some¹ (līt′səm), *adj.* 1. light, esp. in form, appearance, or movement; airy; buoyant; agile; nimble; graceful. 2. cheerful; gay; lighthearted. 3. frivolous; changeable. [1350–1400; ME *lyghtesum* (c. MHG *lihtsam*). See LIGHT², -SOME¹] —**light′some·ly,** *adv.* —**light′some·ness,** *n.*

light·some² (līt′səm), *adj.* 1. emitting or reflecting light; luminous. 2. well-lighted; illuminated; bright. [1400–50; late ME *lyghtesum.* See LIGHT¹, -SOME¹] —**light′some·ly,** *adv.* —**light′some·ness,** *n.*

lights′ out′, 1. *Chiefly Mil.* a signal, usually by drum or bugle, that all or certain camp or barracks lights are to be extinguished for the night. 2. bedtime. [1865–70]

light-struck (līt′struk′), *adj. Photog.* (of a film or the like) damaged by accidental exposure to light. [1880–85]

light′ ta′ble, a table that has a translucent top illuminated from below and is used typically for making tracings or examining color transparencies.

light′ ther′apy, *Med.* therapeutic exposure to full-spectrum artificial light that simulates sunlight, used to treat various conditions, as seasonal affective disorder. Also called **phototherapy.**

light·tight (līt′tīt′), *adj. Chiefly Brit.* lightproof. [1880–85; LIGHT¹ + TIGHT, on the model of WATERTIGHT, AIRTIGHT, etc.]

light′ valve′, *Elect.* a light-transmitting device having transmissions that vary in accordance with an electric input, as voltage, current, or an electron beam, used chiefly for recording sound on motion-picture film. [1925–30]

light′ verse′, verse that is written to entertain, amuse, or please, often by the subtlety of its form rather than by its literary quality.

light′ weight′, *Naut.* See **light displacement.** [1765–75]

light·weight (līt′wāt′), *adj.* 1. light in weight. 2. being lighter in weight, texture, etc., than another item or object of identical use, quality, or function: *a lightweight topcoat; a lightweight alloy for ship construction.* 3. without seriousness of purpose; trivial or trifling: *lightweight reading.* 4. of or pertaining to a lightweight: *He's the new lightweight contender.* 5. (of a horse, esp. a hunter) able to carry up to 165 lb. (75 kg). —*n.* 6. a person of less than average weight. 7. *Informal.* a person who is of little influence, importance, or effect. 8. a boxer or other contestant intermediate in weight between a featherweight and a welterweight, esp. a professional boxer weighing between 126 and 135 lb. (56.7–61 kg). [1765–75; LIGHT² + WEIGHT]

light·wood (līt′wŏŏd′, -ðŏd), *n. Southern U.S.* 1. Also called **fatwood.** kindling. 2. resinous pine wood used for kindling. [1675–85; LIGHT¹ + WOOD¹]

light-year (līt′yēr′, -yēr′), *n.* 1. *Astron.* the distance traversed by light in one mean solar year, about 5.88 trillion mi. (9.46 trillion km): used as a unit in measuring stellar distances. *Abbr.:* lt-yr 2. **light-years,** a. a very great distance, esp. in development or progress: *The new computer is light-years ahead of the old one.* b. a very long time: *It's been light-years since I've seen my childhood friends.* [1885–90]

lign-, var. of **ligni-** before a vowel: *lignite.*

lign·al·oes (li nal′ōz, lig-), *n.* (*used with a singular v.*) agalloch. [1325–75; ME *ligne aloes* < ML *lignum aloēs* wood of the aloe. See LIGN-, ALOE]

ligne (lēn; *Fr.* lēn′y³), *n., pl.* **lignes** (lēnz; *Fr.* lēn′y³). 1. (in Swiss watchmaking) a unit equal to 0.0888 inch or 2.2558 millimeters, divided into 12 douziemes: used mainly to gauge the thickness of a movement. 2. line¹ (def. 44). [< F: LINE¹]

lig·ne·ous (lig′nē əs), *adj.* of the nature of or resembling wood; woody. [1620–30; < L *ligneus* of wood. See LIGN-, -EOUS]

ligni-, a combining form meaning "wood," used in the formation of compound words: *ligniform.* Also, **ligno-;** *esp. before a vowel,* **lign-.** [< L, comb. form repr. *lignum* wood]

lig·ni·form (lig′nə fôrm′), *adj.* having the form of wood; resembling wood, as a variety of asbestos. [1790–1800; LIGNI- + -FORM]

lig·ni·fy (lig′nə fī′), *v.*, **-fied, -fy·ing.** —*v.t.* 1. to convert into wood; cause to become woody. —*v.i.* 2. to become wood or woody. [1820–30; LIGNI- + -FY] —**lig′ni·fi·ca′tion,** *n.*

lig·nin (lig′nin), *n.* 1. *Bot.* an organic substance that, with cellulose, forms the chief part of woody tissue. 2. *Papermaking.* impure matter found in wood pulp. [1815–25; LIGN- + -IN²]

lig′nin sul′fonate, *Chem.* a brown powder consisting of a sulfonate salt made from waste liquor of the sulfate pulping process of soft wood: used in concrete, leather tanning, as an additive in oil-well drilling mud, and as a source of vanillin. Also called **lig·no·sul·fo·nate** (lig′nə sul′fə nāt′).

lig·nite (lig′nīt), *n.* a soft coal, usually dark brown, often having a distinct woodlike texture, and intermediate in density and carbon content between peat and bituminous coal. [1800–10; LIGN- + -ITE¹] —**lig·nit·ic** (lignit′ik), *adj.*

lig′nite wax′. See **montan wax.**

lig·niv·or·ous (lig niv′ər əs), *adj.* xylophagous. [1820–30; LIGNI- + -VOROUS]

ligno-, var. of **ligni-:** *lignocellulose.*

lig·no·caine (lig′nə kān′), *n. Pharm.* lidocaine. [1950–55; LIGNO- + (*xylo*)*caine* an earlier name (LIGNO- being the L version of XYLO-); for *-caine,* see LIDOCAINE]

lig·no·cel·lu·lose (lig′nō sel′yə lōs′), *n. Bot.* any of various compounds of lignin and cellulose comprising the essential part of woody cell walls. [1895–1900; LIGNO- + CELLULOSE] —**lig·no·cel·lu·los·ic** (lig′nō sel′yə los′ik), *adj.*

lig·num vi·tae (lig′nəm vī′tē, vē′ti), 1. either of two tropical American trees, *Guaiacum officinale* or *G. sanctum,* of the caltrop family, having very hard, heavy wood. 2. the wood of such a tree, used for making pulley blocks, mallet heads, bearings, etc. 3. any of several other trees yielding a similar hard wood. [1585–95; < NL, LL, name of the tree, lit., wood of life]

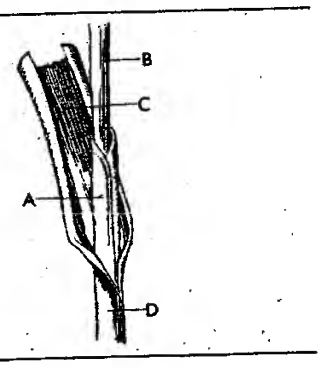
lig·ro·in (lig′rō in), *n.* a flammable mixture of hydrocarbons that boils at from 20°C to 135°C, obtained from petroleum by distillation and used as a solvent. Also, **lig′ro·ine.** [1880–85; orig. obscure]

lig′ snail′ (lig). See **banded Florida tree snail.**

lig·u·la (lig′yə lə), *n., pl.* **-lae** (-lē′), **-las.** 1. *Bot., Zool.* a tonguelike or strap-shaped part or organ. 2. *Bot.* ligule. [1750–60; < NL, special use of L *li(n)gula* spoon, shoe-strap, equiv. to *lig-,* var. s. of *lingere* to LICK + *-ula* -ULE] —**lig′u·lar,** *adj.* —**lig′u·loid′,** *adj.*

lig·u·late (lig′yə lit, -lāt′), *adj.* 1. having or forming a ligula. 2. having the shape of a strap. Also, **lig·u·la·ted** (lig′yə lā′tid). [1745–55; LIGUL(A) + -ATE¹]

lig·ule (lig′yōōl), *n. Bot.* 1. a thin, membranous outgrowth from the base of the blade of most grasses. 2. a strap-shaped corolla, as in the ray flowers of the head of certain composite plants. [1595–1605; < L *ligula;* see LIGULA]



A, **ligule** of a grass section; B, stem; C, leaf blade; D, leaf sheath

lig·ure (lig′yŏŏr), *n.* a precious stone, probably the jacinth. Ex. 28:19. [1275–1325; ME *ligury* < LL *ligūrius* < LGk *ligýrion* a kind of precious stone]

Li·gu·ri·a (li gyŏŏr′ē ə), *n.* a region in NW Italy. 1,881,982; 2099 sq. mi. (5435 sq. km).

Li·gu·ri·an (li gyŏŏr′ē ən), *n.* 1. an apparently Indo-European language used in ancient times along the NW coast of the Ligurian Sea. —*adj.* 2. of or pertaining to Liguria or its inhabitants. [1595–1605; LIGURI(A) + -AN]

Ligu′rian Repub′lic, the republic in NW Italy set up by Napoleon in 1797, incorporated into France in 1805, and united with the Kingdom of Sardinia in 1814.

Ligu′rian Sea′, a part of the Mediterranean between Corsica and the NW coast of Italy.

RELATED PROCEEDINGS APPENDIX

There are no related proceedings.